

REN

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"TECHNIQUES FOR AUTOMATED PROGNOSIS OF FAILURE
IN MILITARY AUTOMOTIVE VEHICLES"

BY

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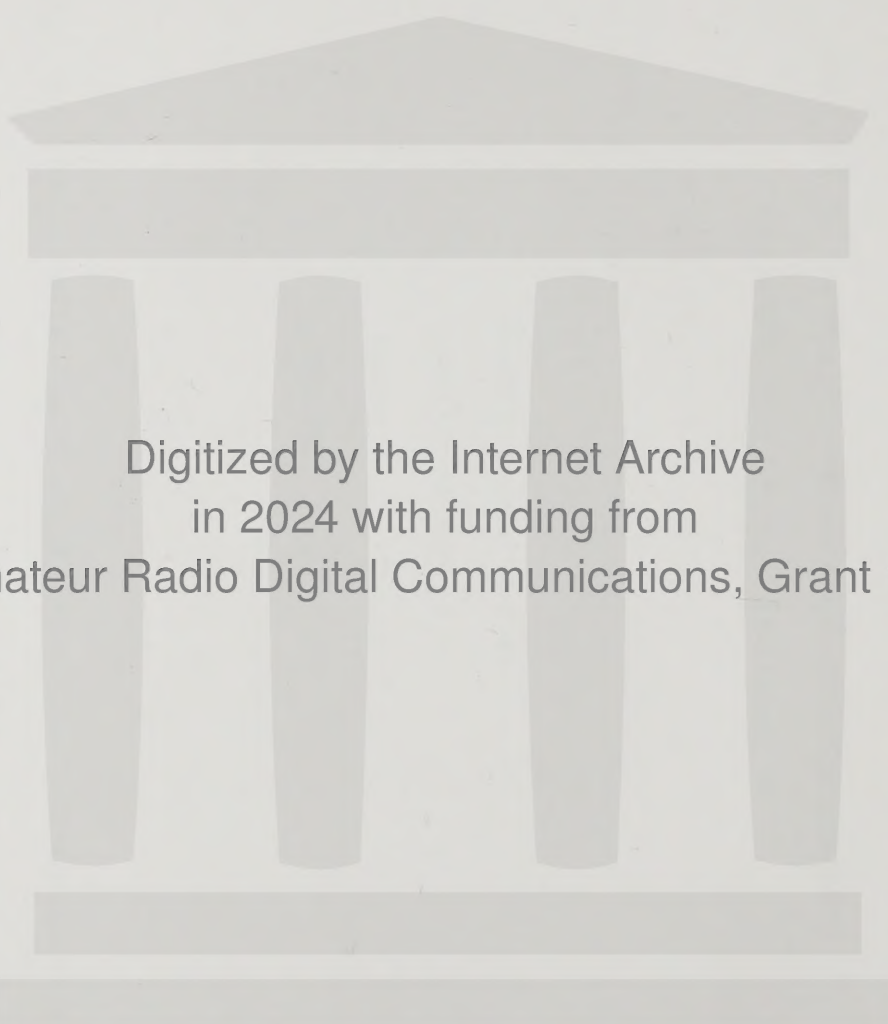
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SUMMARY

- OVERVIEW OF STE/ICE (SIMPLIFIED TEST EQUIPMENT FOR
INTERNAL COMBUSTION ENGINE-POWERED MATERIAL)

- DIESEL TESTING "WITHOUT CONNECTIONS"

- EARLY FAULT DETECTION TECHNIQUE

- APPLICATIONS TO PROGNOSIS

J1
TEST

J2
VOLTS/OHMS

M151A2 TRUCK
1/4 TON

M35A2 TRUCK
3 1/2 TON

M113A1 ARMV
DEUC CARRIED

M48A3
TANK

ALL VEHICLES
XDCR KIT

905 DWELL ANGLE
906 0 TO 39 VOLTS DC (GROUNDED)
907 0 TO 1 VOLT DC (GROUNDED)
910 0 TO 100 AMPS
911 0 TO 1000 AMPS
914 0 TO 2000 OHMS (GROUNDED)

POINTS ADAPTER
TEST LEADS (J2)
TEST LEADS (J2)
CURRENT PROBE
CURRENT PROBE
TEST LEADS (J2)

915 0 TO 20K OHMS (GROUNDED)
920 TRANSDUCER TEST, 0 TO 30 IN. HG (VAC)
921 0 TO 30 IN. HG, VACUUM
922 0 TO 20 IN. HG, VACUUM VARIATION
924 TRANSDUCER TEST, 0 TO 300 PSIG
925 0 TO 300 PSIG PRESSURE

TEST LEADS (J2)

18

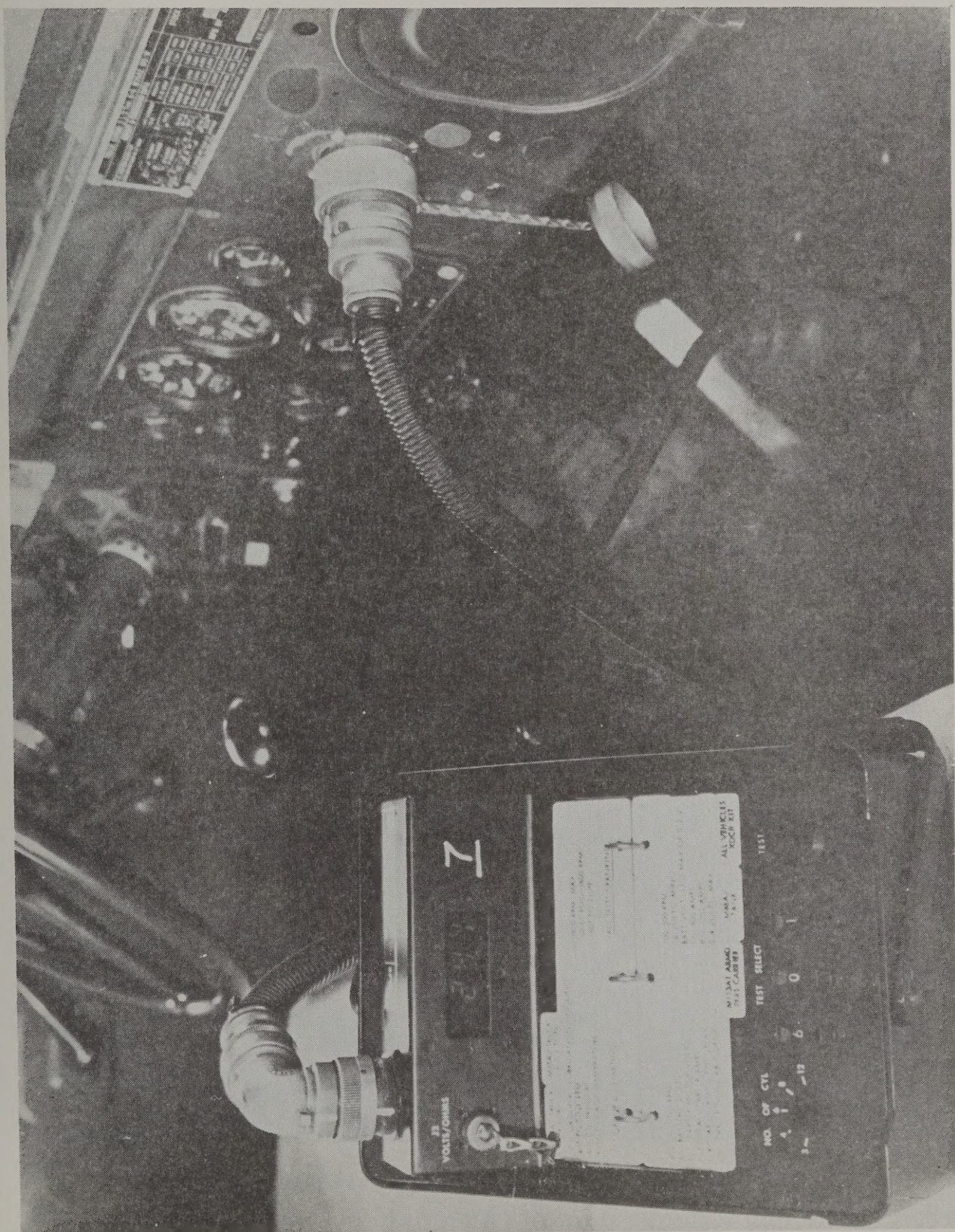
NO. OF CYL

3 4 6 8 12

TEST SELECT

9 0 5

TEST



1.42

1.42

1.42

1.42

1.42

1.42

1.42

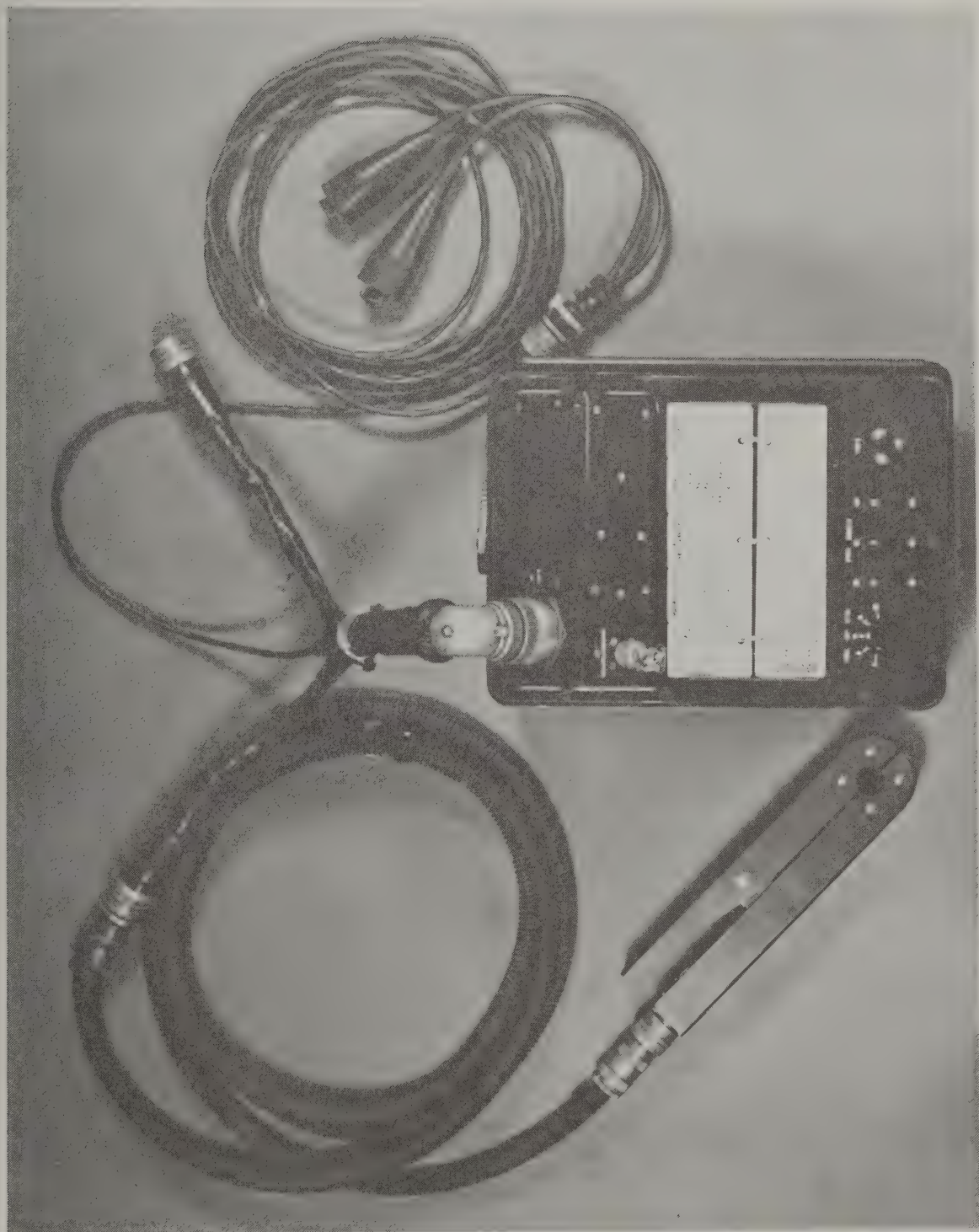
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REA STE/ICE Functional Capability

PRESENT AUTOMOTIVE TMDE

- LOW VOLTAGE CIRCUIT TESTER (LVCT)
- MULTIMETER
- TACHOMETER (GAS & DIESEL)
- DWELL METER
- VACUUM GAUGE
- ASSORTED PRESSURE GAUGES
- COMPRESSION TESTER
- TIMING LIGHT

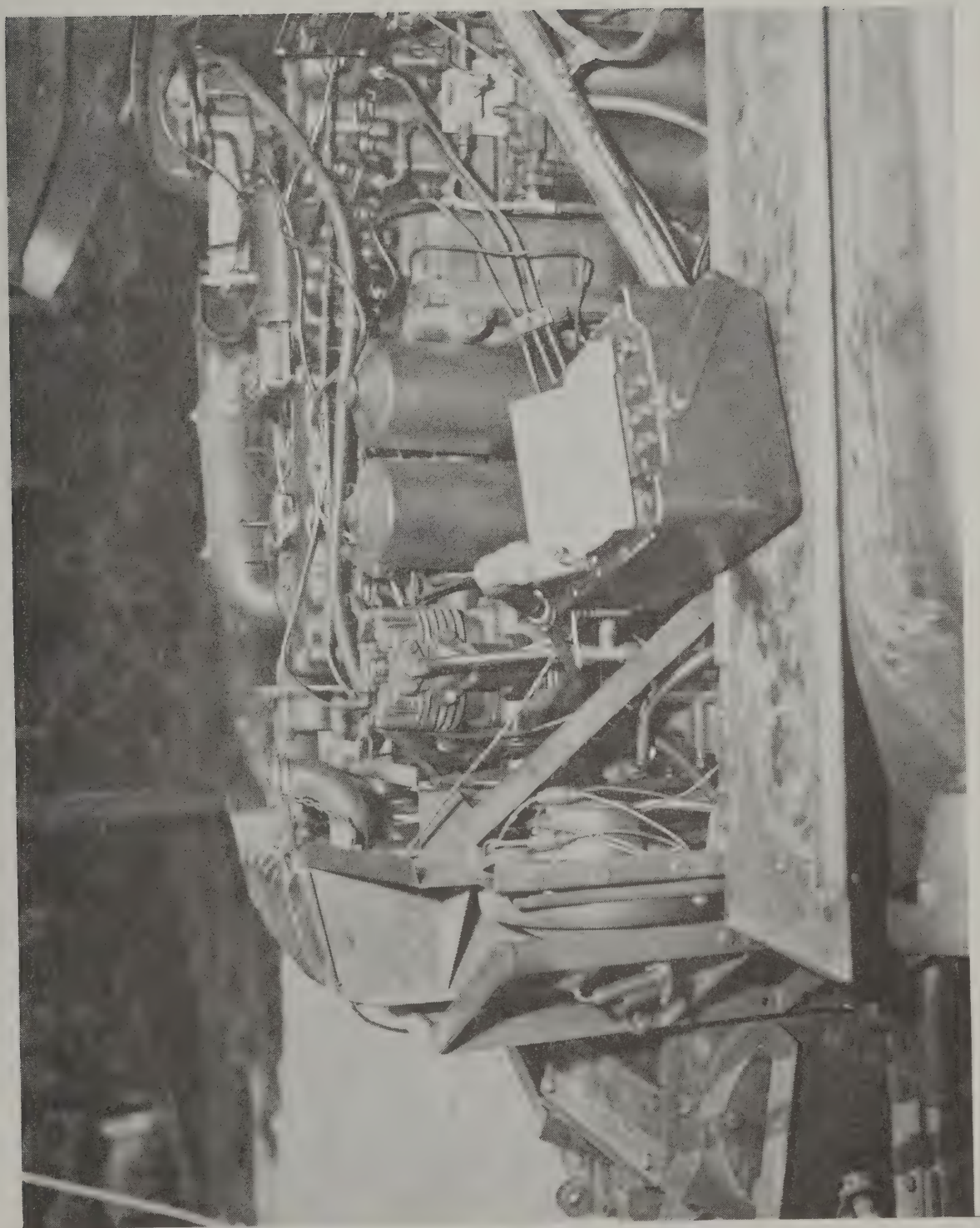
PLUS NEW CAPABILITY

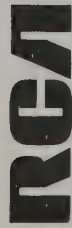
- QUICK-CHECK POWER TEST (GAS & DIESEL)
- QUICK-CHECK COMPRESSION BALANCE TEST
- DYNAMIC ELECTRICAL CHECK
- SELF TEST OF STE/ICE



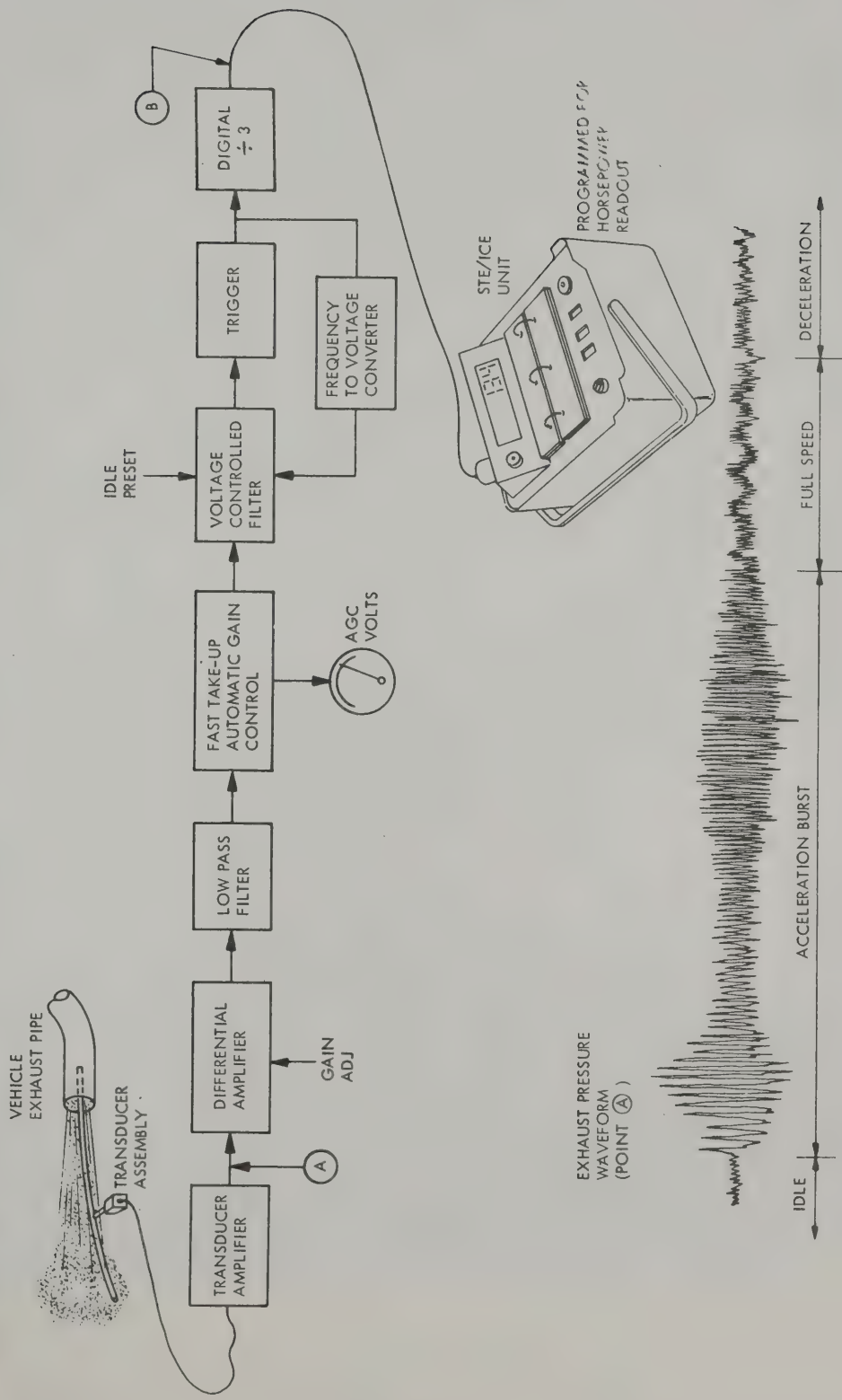
STE/ICE Compression Ignition (Diesel) Power Test

- FULL LOAD ON COMPRESSION AND FUEL/AIR SYSTEM DURING ACCELERATION BURST
- INERTIAL ACCELERATION LOAD
- FRICTION COMPENSATION FROM DECELERATION
- NET OUTPUT TORQUE = f (ACCEL, DECEL)



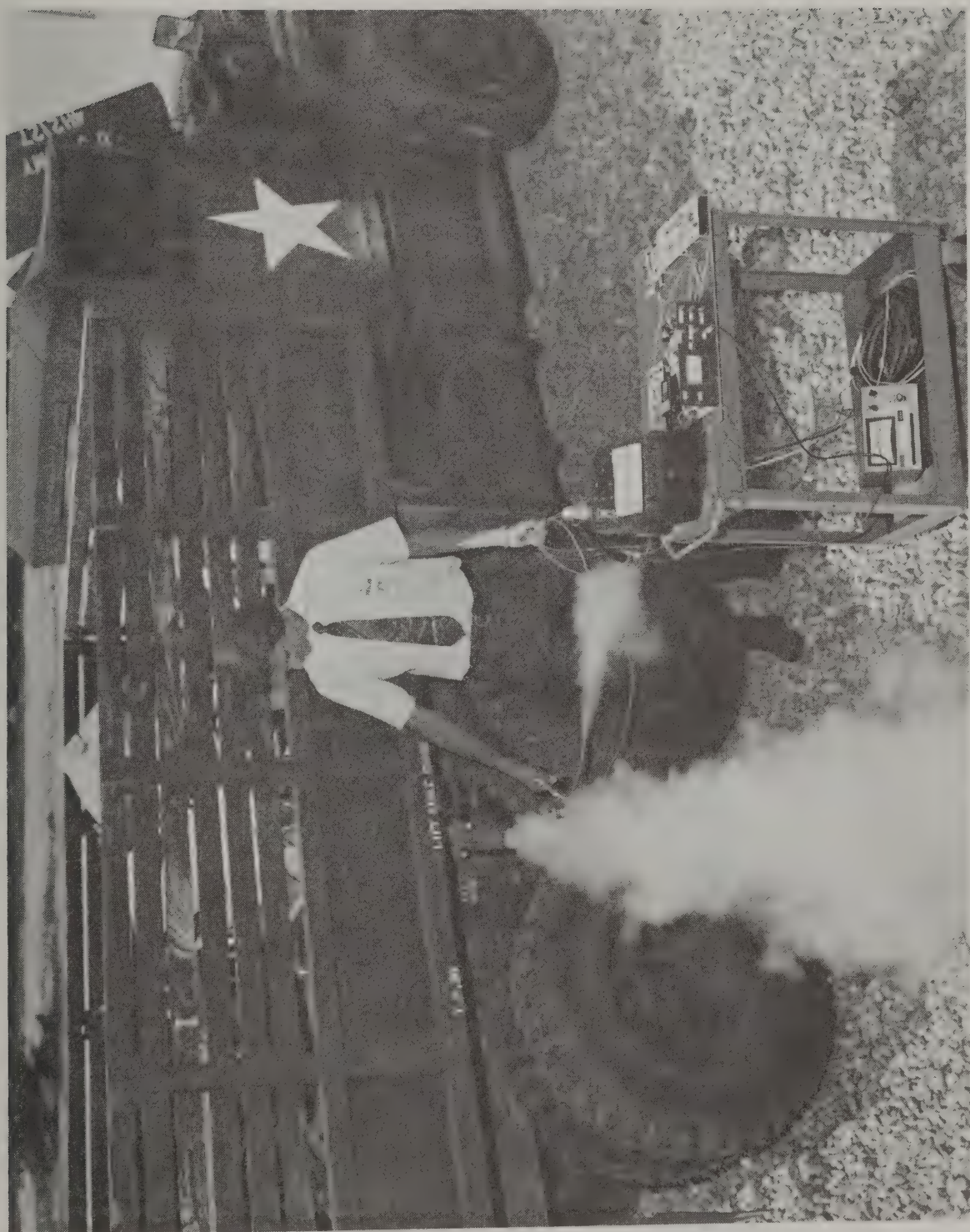


Non-Contact Power Test System



OUTPUT WAVEFORM TO STE/ICE UNIT (POINT (B))





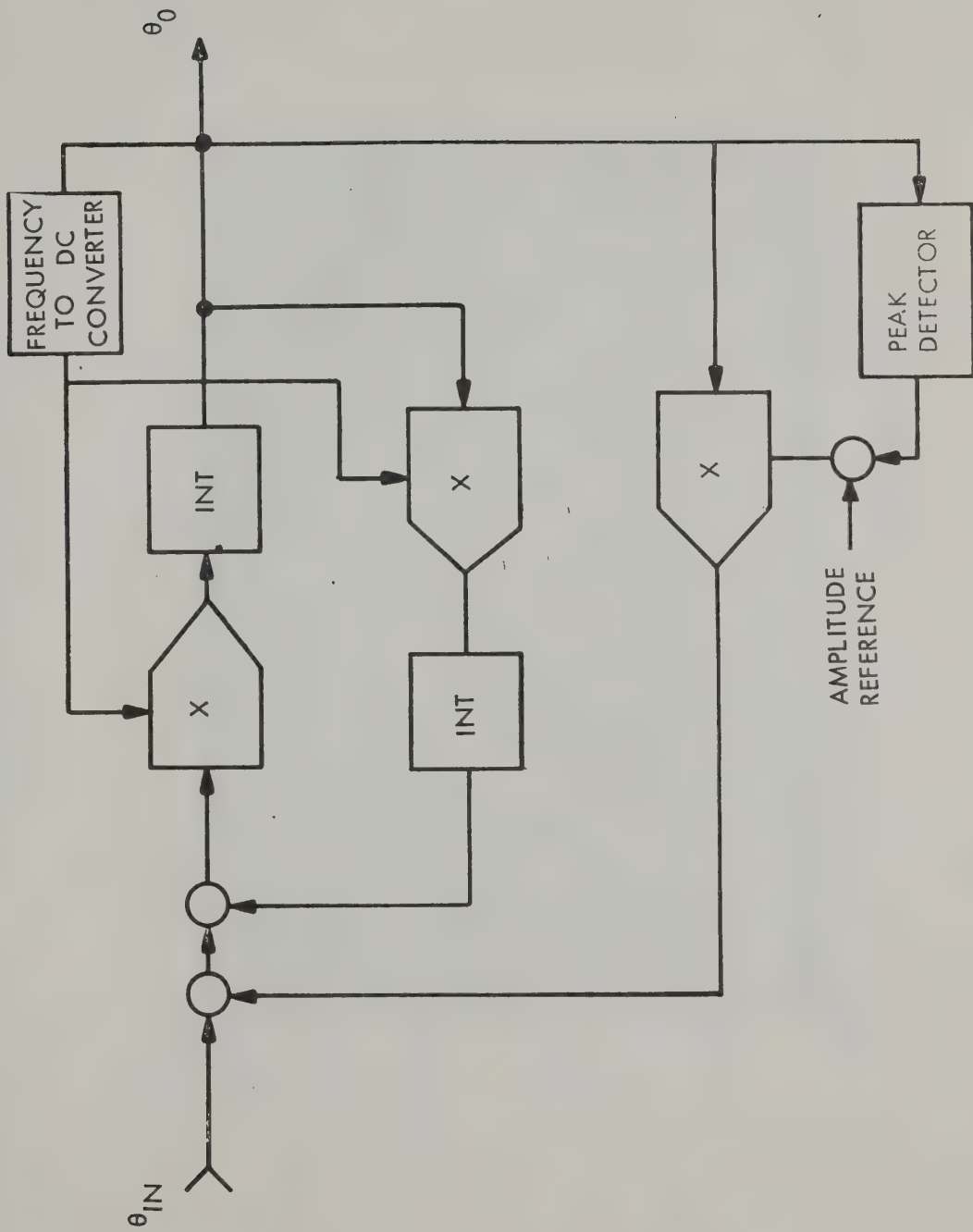
RCA

Government and
Commercial Systems

Exhaust Pressure Transducer



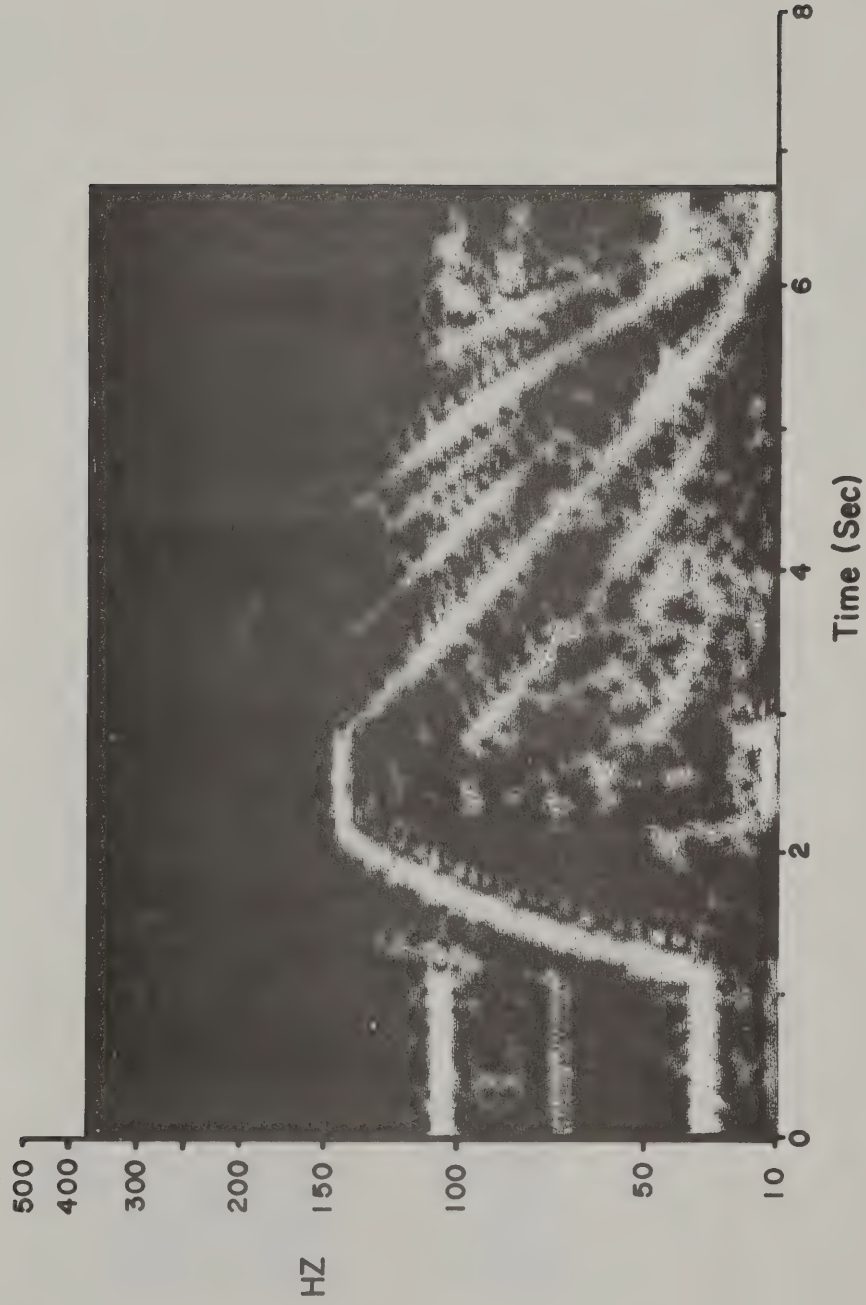
Physical Implementation of Filter

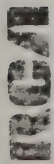




Government and
Commercial Systems

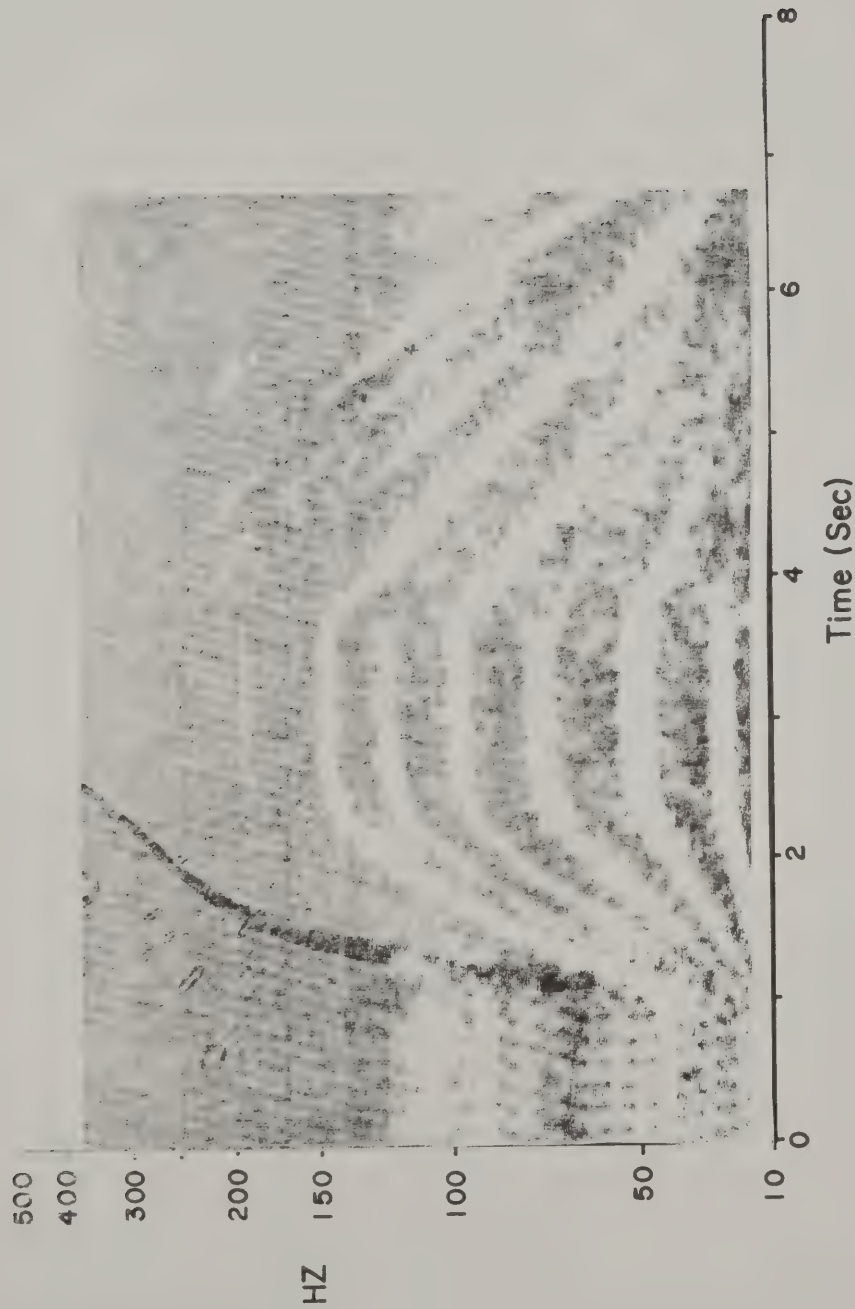
Sonagram of Exhaust Pressure



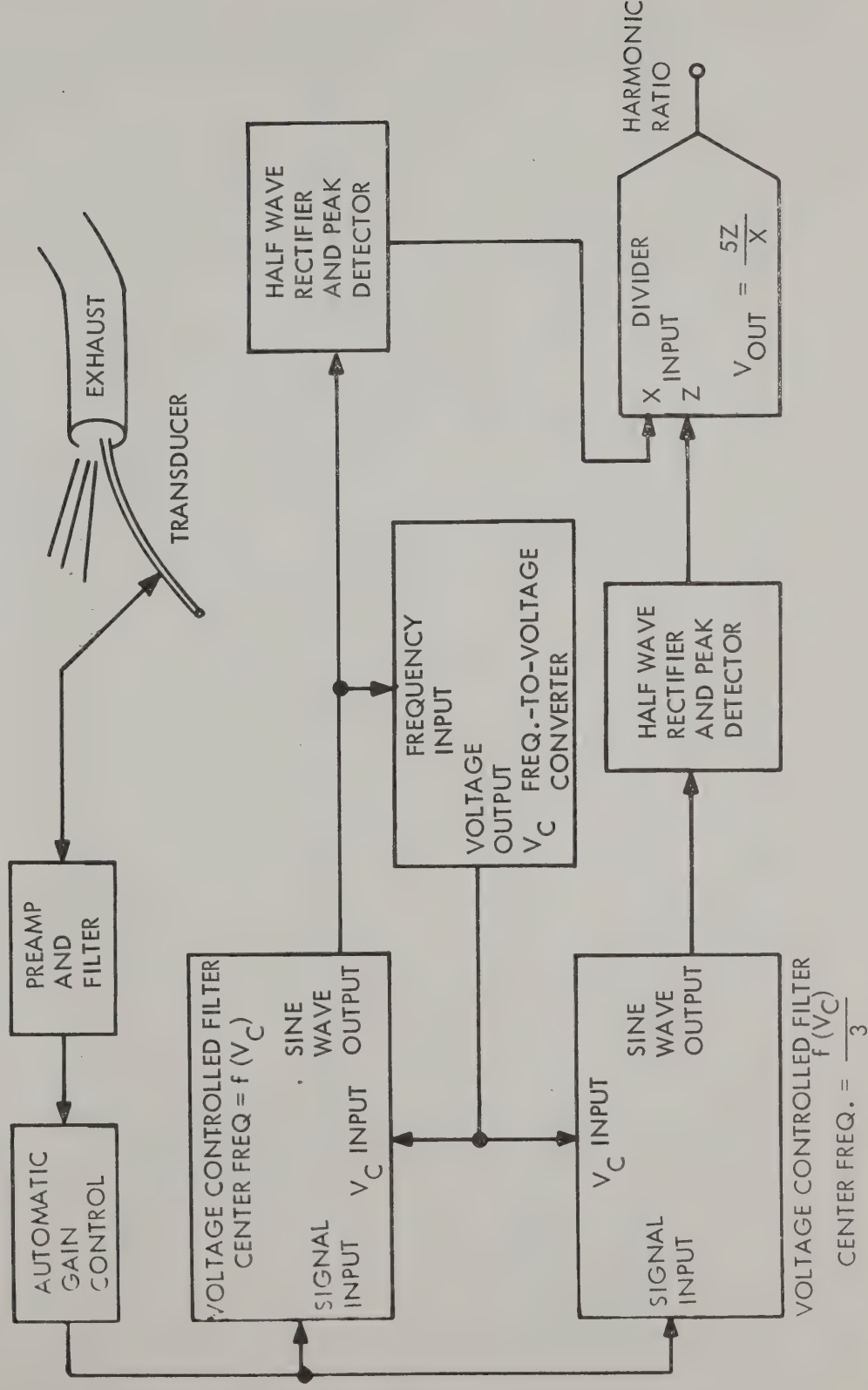


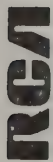
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Sonagram of Exhaust Pressure Faulty Engine



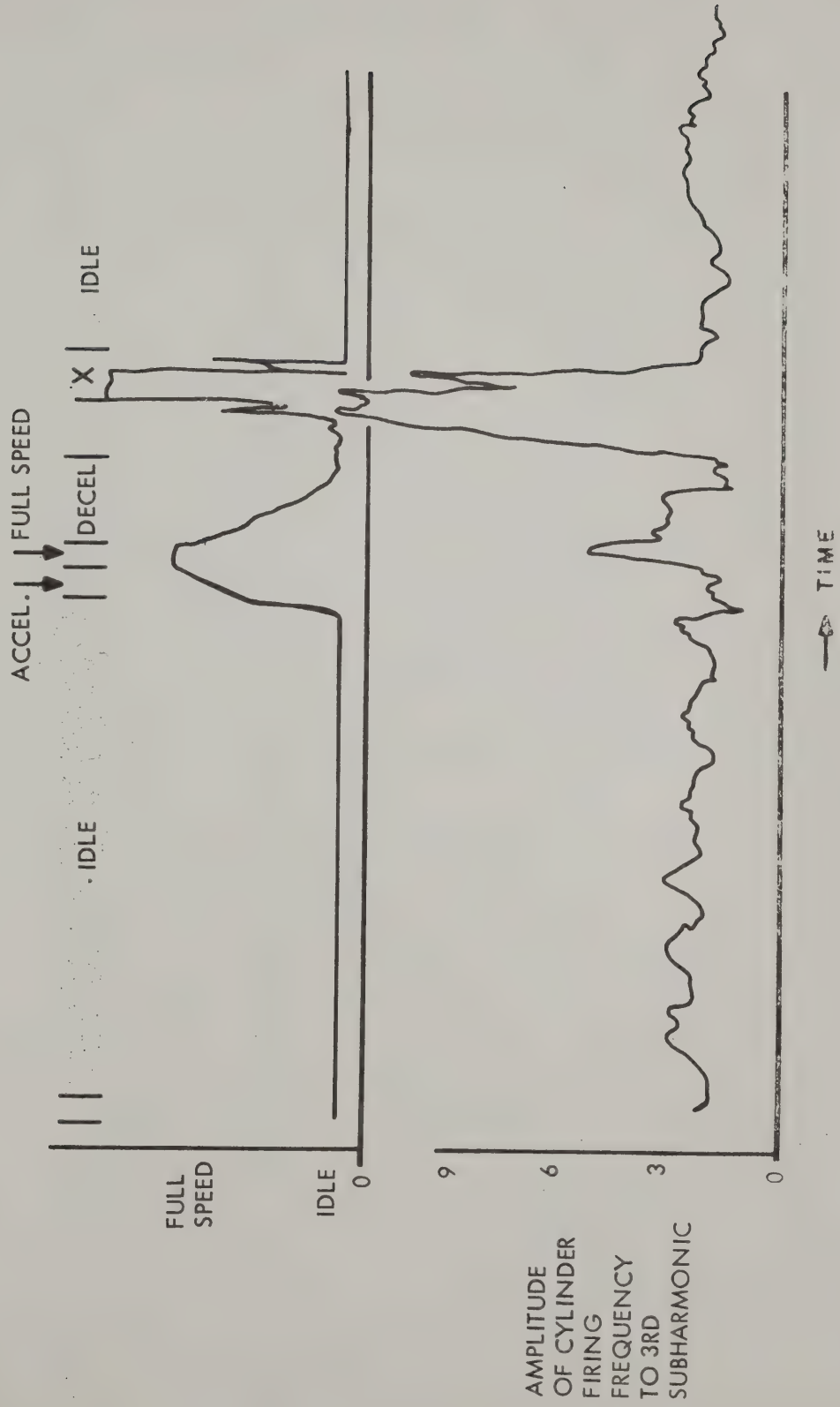
Block Diagram of Harmonic Ratio Tracker





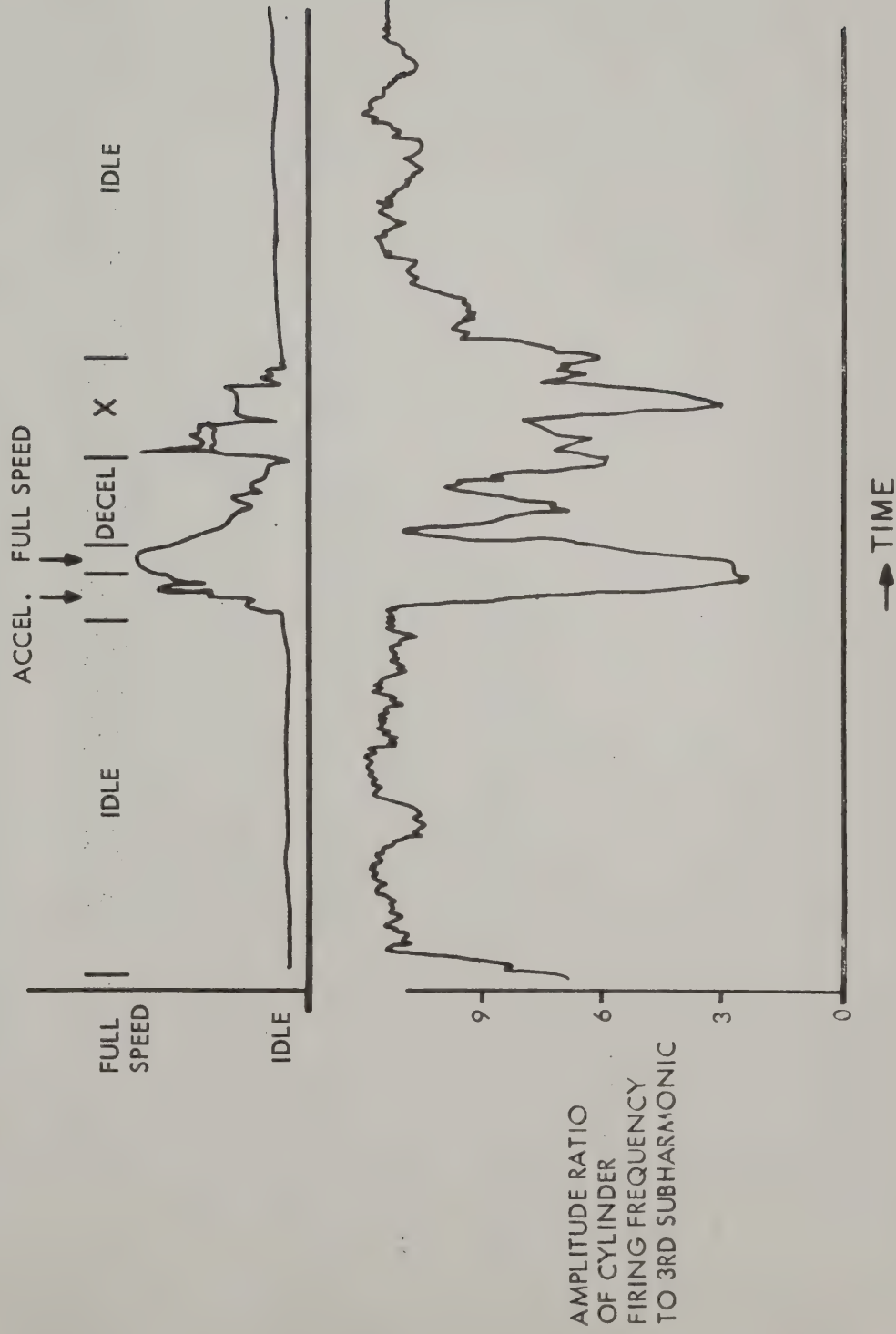
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Commercial Systems

Ratio of 3rd Sub Harmonic for Normal Engine



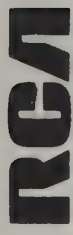


Ratio of 3rd Sub-Harmonic for Engine with Minor Valve Fault



DYNAMIC WAVE TRACKER

- AUTOMATIC TRACKING OF FUNDAMENTAL SELECTED HARMONIC(S)
- VARIABLE Q (BAND WIDTH/CENTER FREQUENCY)
- MAKES "OLD" SENSORS GIVE NEW ANSWERS
- MAY PROVIDE MOTIVATION FOR NEW SENSORS:
 - EASIER TO DEFINE AND MAKE
 - CHEAPER
 - HIGHER SURVIVABILITY



DYNAMIC WAVE TRACKER (ENGINE APPLICATIONS)

Q PROBLEM:

HIGHLY SENSITIVE TO MINOR DEFECTS

A OPPORTUNITY

FIRST CHANCE TO FIND EFFECTS OF SLIGHT WEAR,
MISADJUSTMENTS;

HENCE: PROGNOSIS

DYNAMIC WAVE TRACKER (ENGINE APPLICATIONS)

PROGNOSTIC POTENTIAL

- FOR END-OF-LINE IN FACTORY
- TO DETERMINE INCIPIENT DROP IN FUEL EFFICIENCY
- TO DETERMINE INCIPIENT RISE IN POLLUTANT EMISSION

MULTIPLE APPROACHES TO PROGNOSIS

- MEASUREMENT OF PARAMETERS WITH HIGH FAULT SENSITIVITY
AND EARLY PREDICTIVE VALUE
- FREQUENT RAPID "SURVEY" TESTING OF SUBSYSTEMS USING EITHER
THRESHOLD EXCEEDANCES OR TREND ANALYSIS
- PREDICTIVE VALUE GREATEST FOR: "GRADUAL" FAILURES
PROGRESSIVE TYPE FAILURES

PROGNOSIS STILL NEEDS

- LARGE SAMPLE FOR LIFE AND REFERENCE DATA
- DISCRIMINATION LOGIC TO SEPARATE MULTIPLE FAULTS

REAL

WHAT'S AVAILABLE?

A HIGH RESOLUTION TOOL TO GATHER THE DATA

BENEFITS OF PROGNOSIS

- SAVE PARTS THRU LESS SECONDARY DAMAGE
- INCREASE VEHICLE READINESS THRU LESS DOWNTIME
- SAVE PARTS SUPPLY COSTS BY ENABLING PREDICTIVE MAINTENANCE
(LOGISTICS RESPONSIVE TO PRE-FAILURE NEED)
- SAVE FUEL & FUEL DOLLARS THRU BETTER PERFORMANCE
- REDUCE ACCIDENTS THRU BETTER RELIABILITY

